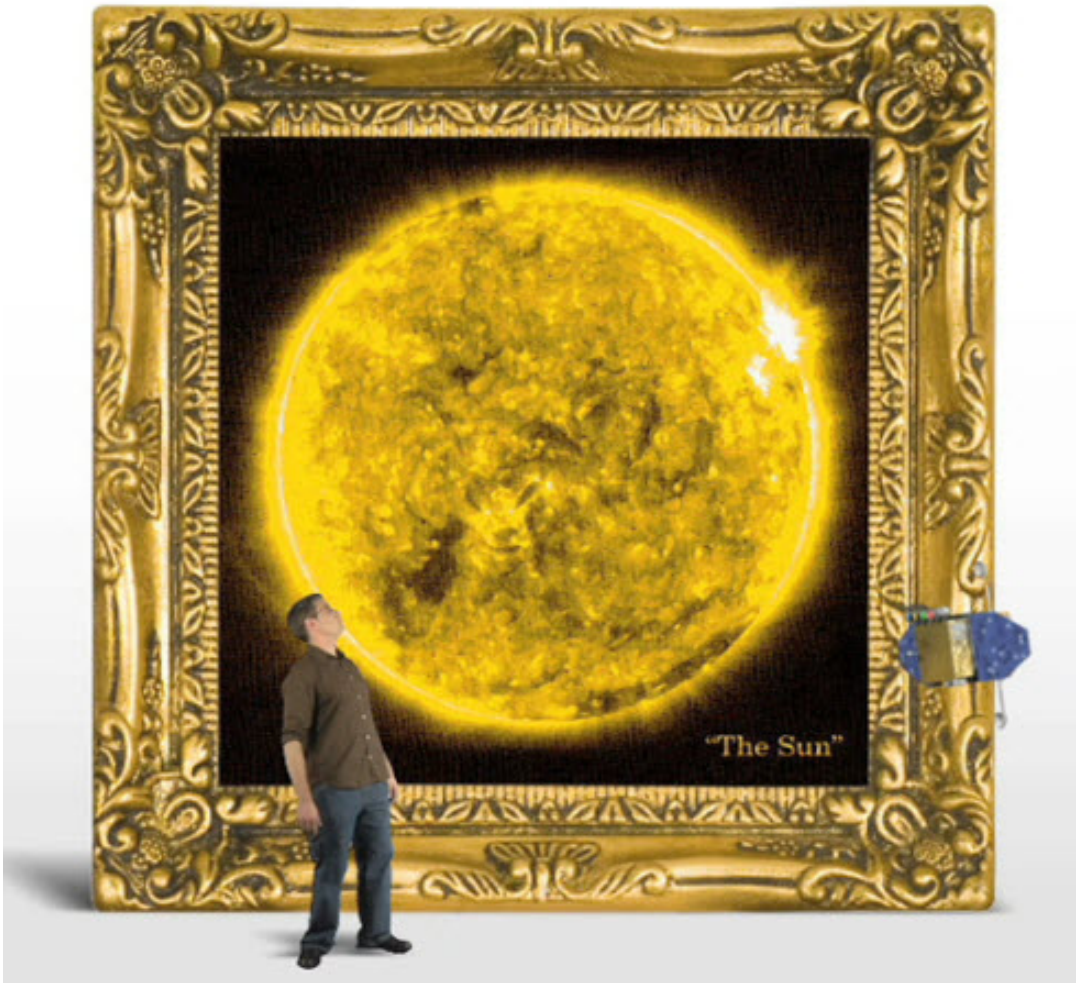
Welcome to the Challenge!

Astronaut Sunita Williams, aboard the International Space Station, invites you to help NASA chart *your* pathway to Mars!

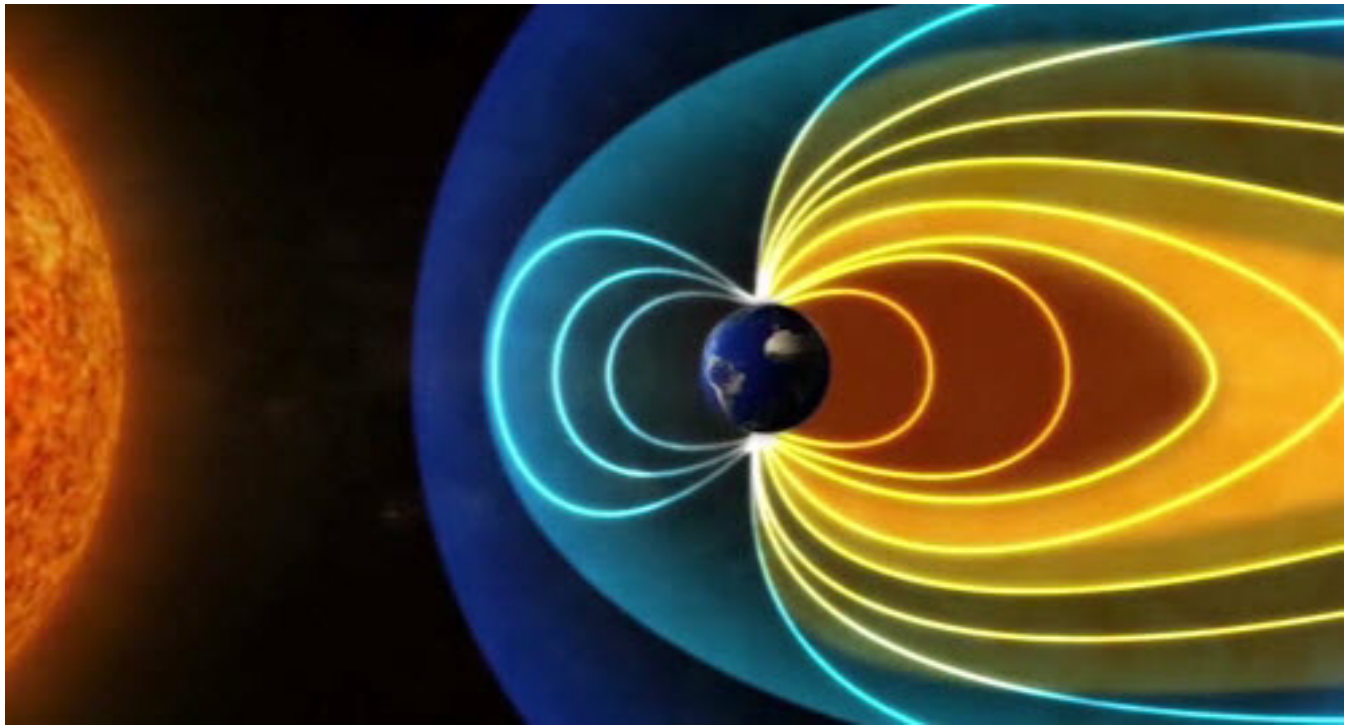
Exploration Design Challenge

Our Sun



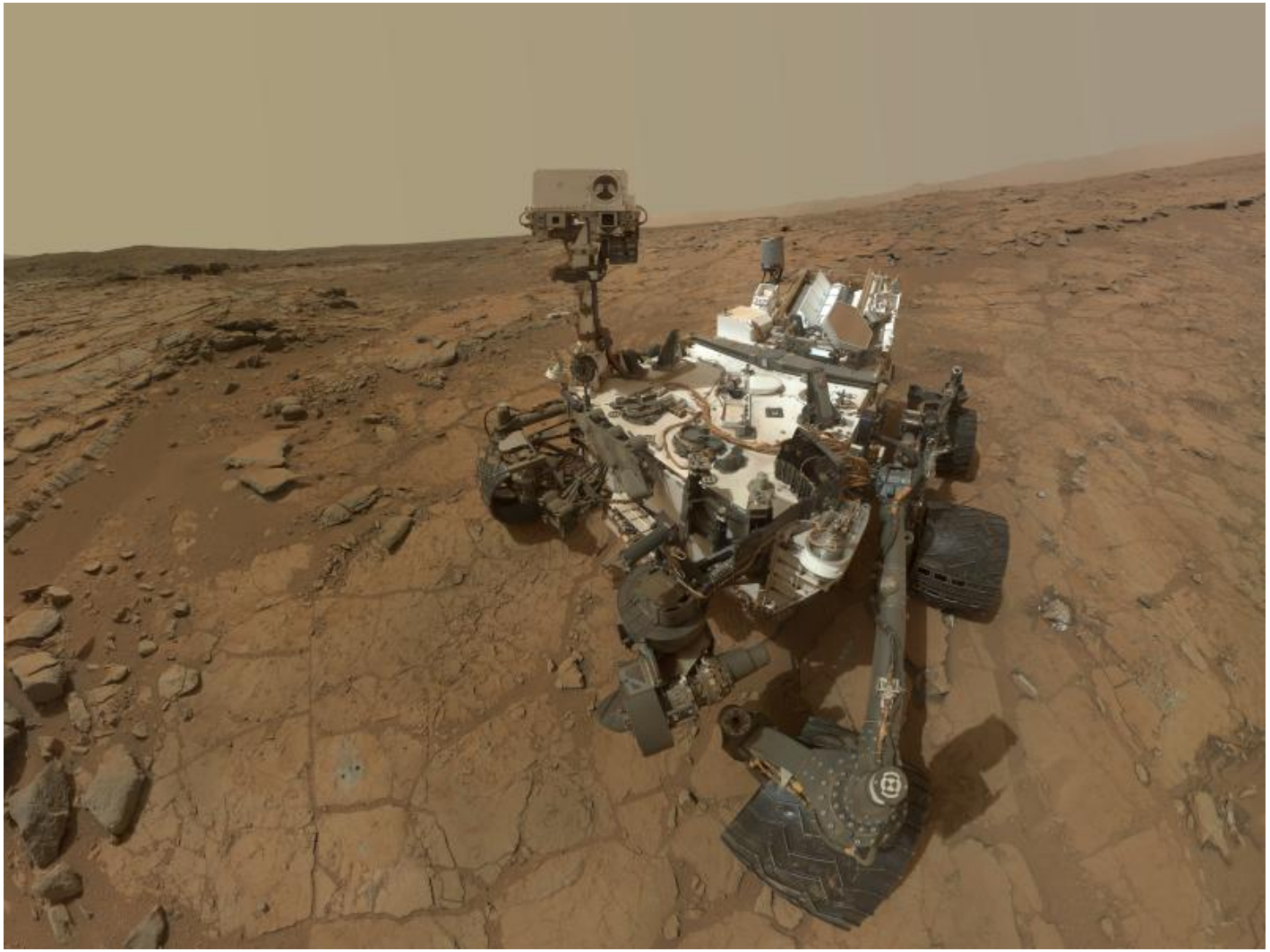
Animation:
http://sdo.gsfc.nasa.gov/gallery/animations/item/248

Protection from Radiation



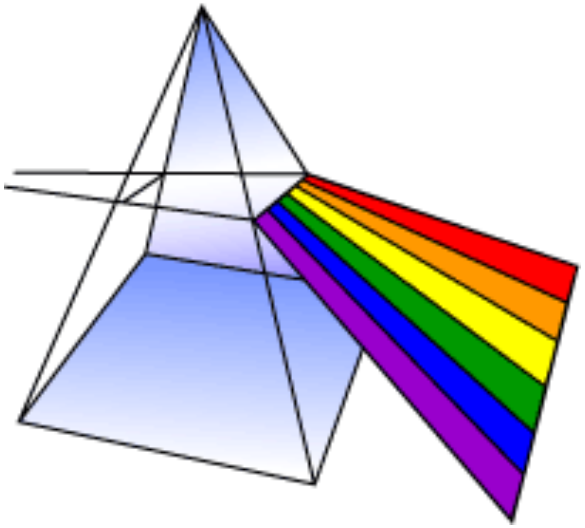
How do Earth's atmosphere and magnetosphere protect us from radiation?

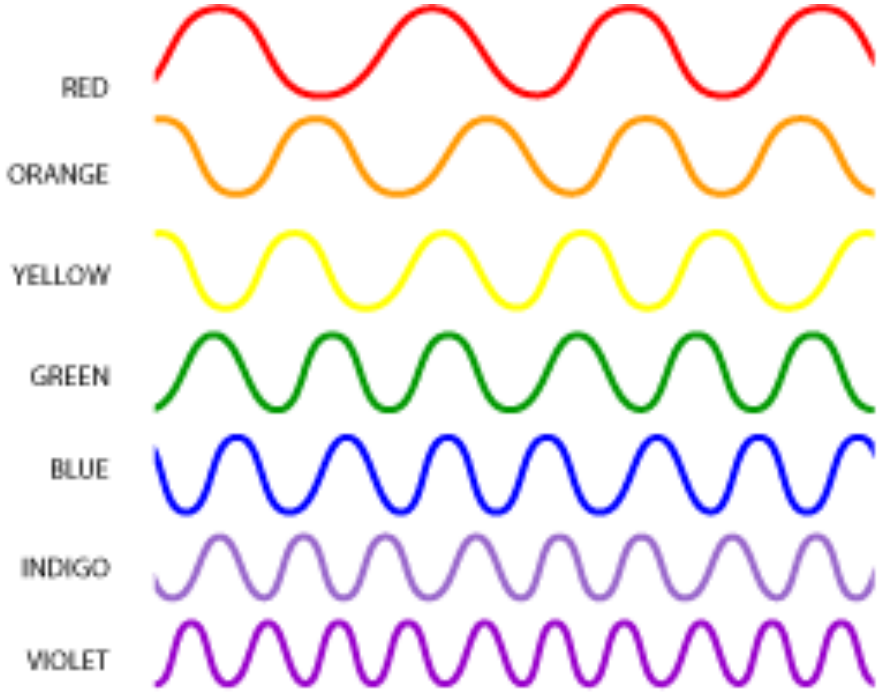
Mars



Mars Science Laboratory

What is Radiation?

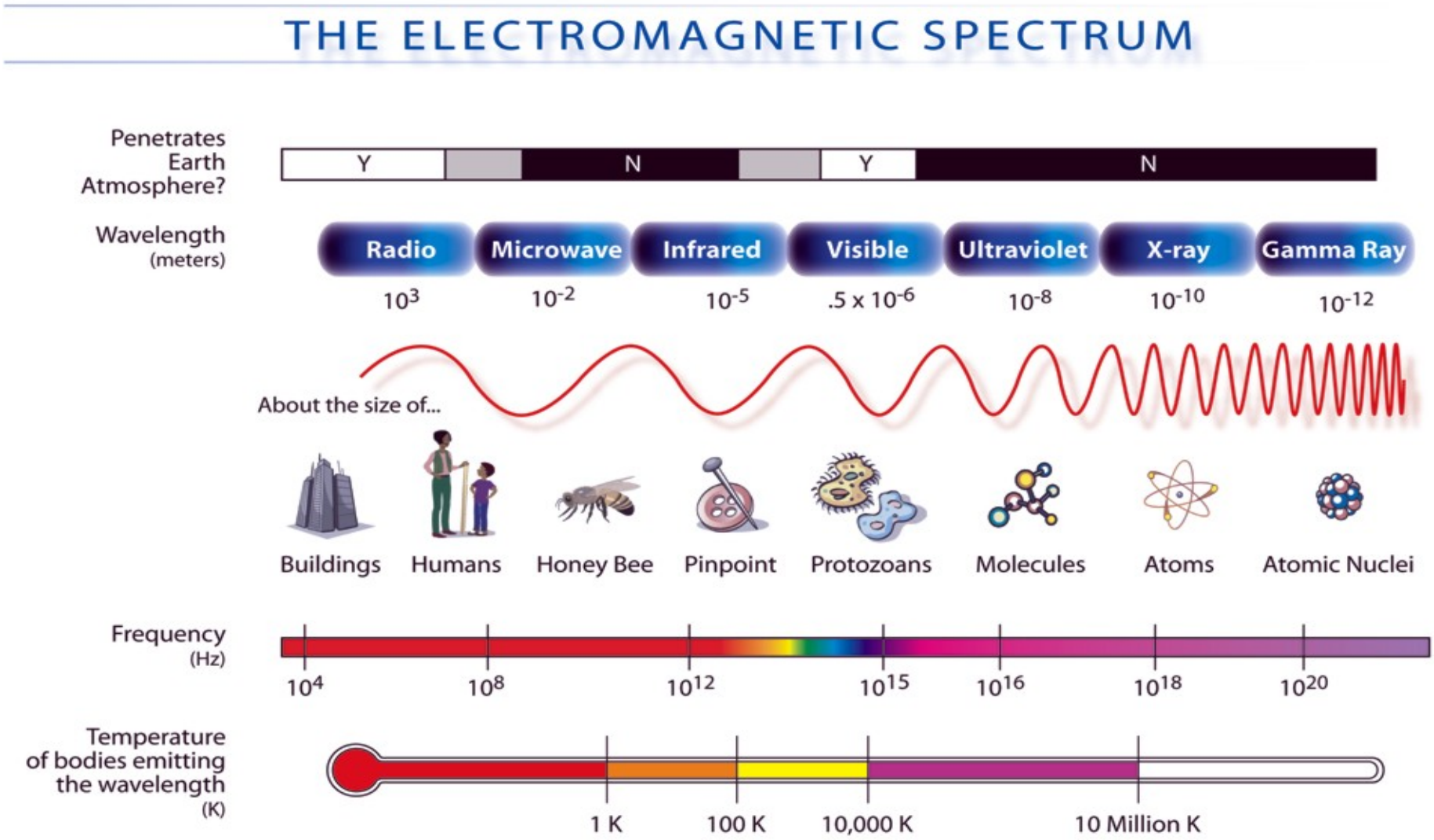




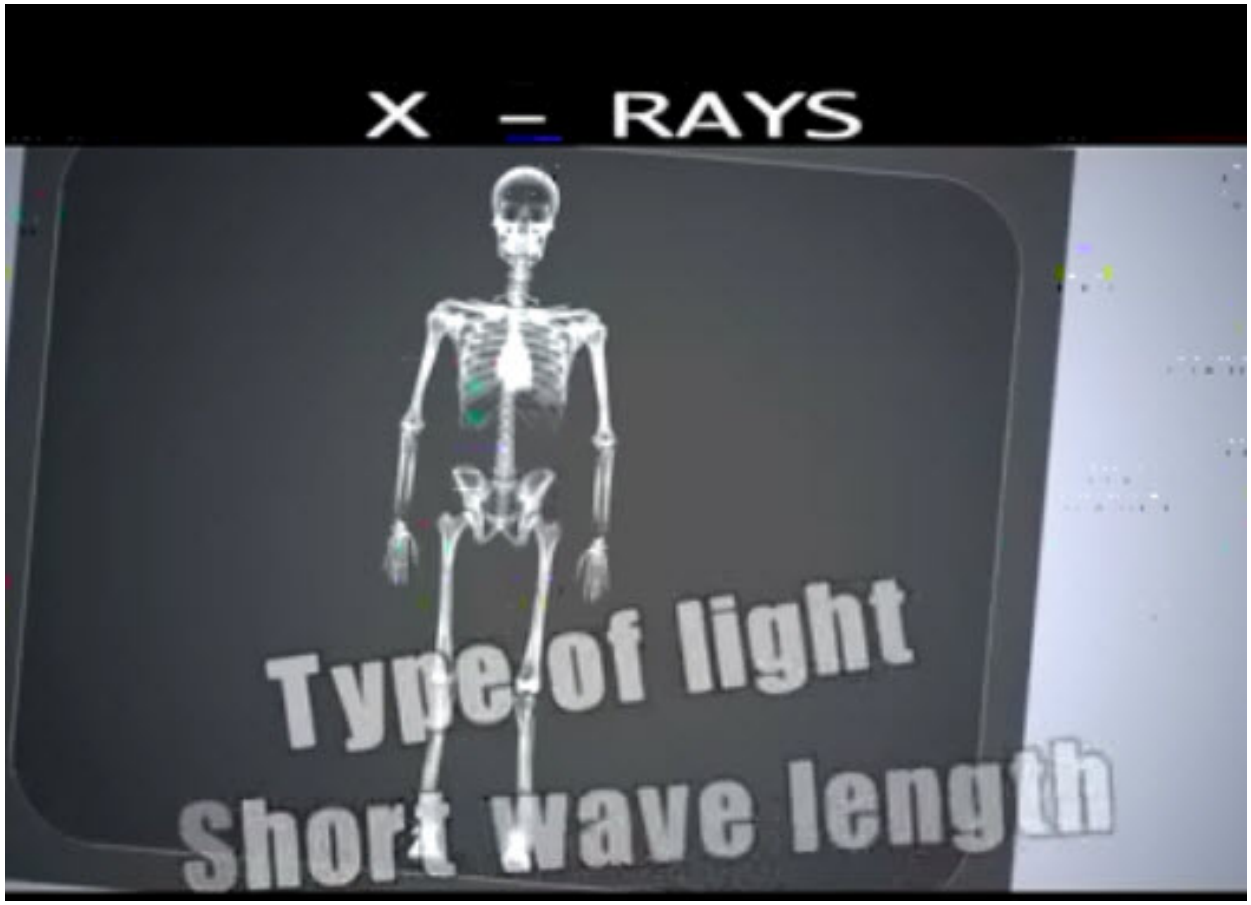
Think first about visible light:

- **Organized by wavelength**
- **Red waves are long – not much energy**
- **Violet are short – lots of energy**

Electromagnetic Spectrum



X-Rays



Transportation Capabilities to Enable Human Space Exploration

Suborbital

Technology payloads and commercial passengers

Low-Earth Orbit (LEO)

Scientific research and technology testing that improves life on Earth and enables future deep space exploration

International Space Station (ISS)

Commercial Cargo

Commercial Crew

GEO

Location for communications support to LEO missions

TDRS-K

Trans-Lunar

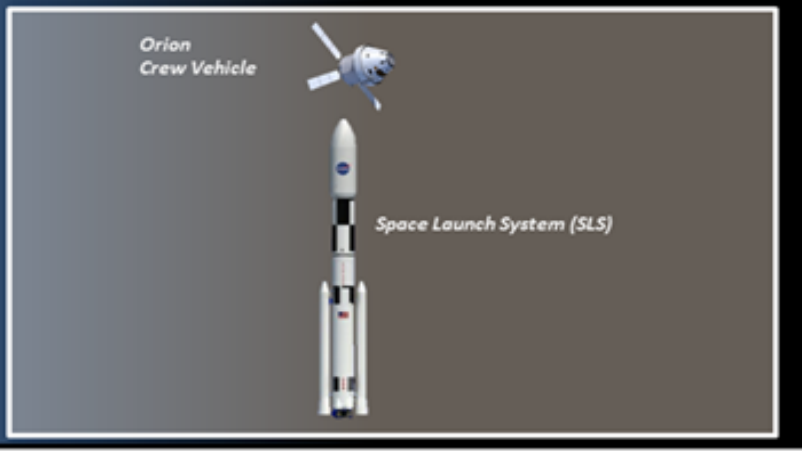
Space environment to test and prove exploration capabilities and operations

Asteroid Retrieval Mission

Deep Space

Human journeys of exploration and discovery, taking us farther into space than ever before

Curiosity (Robotic Precursor to Human Exploration)

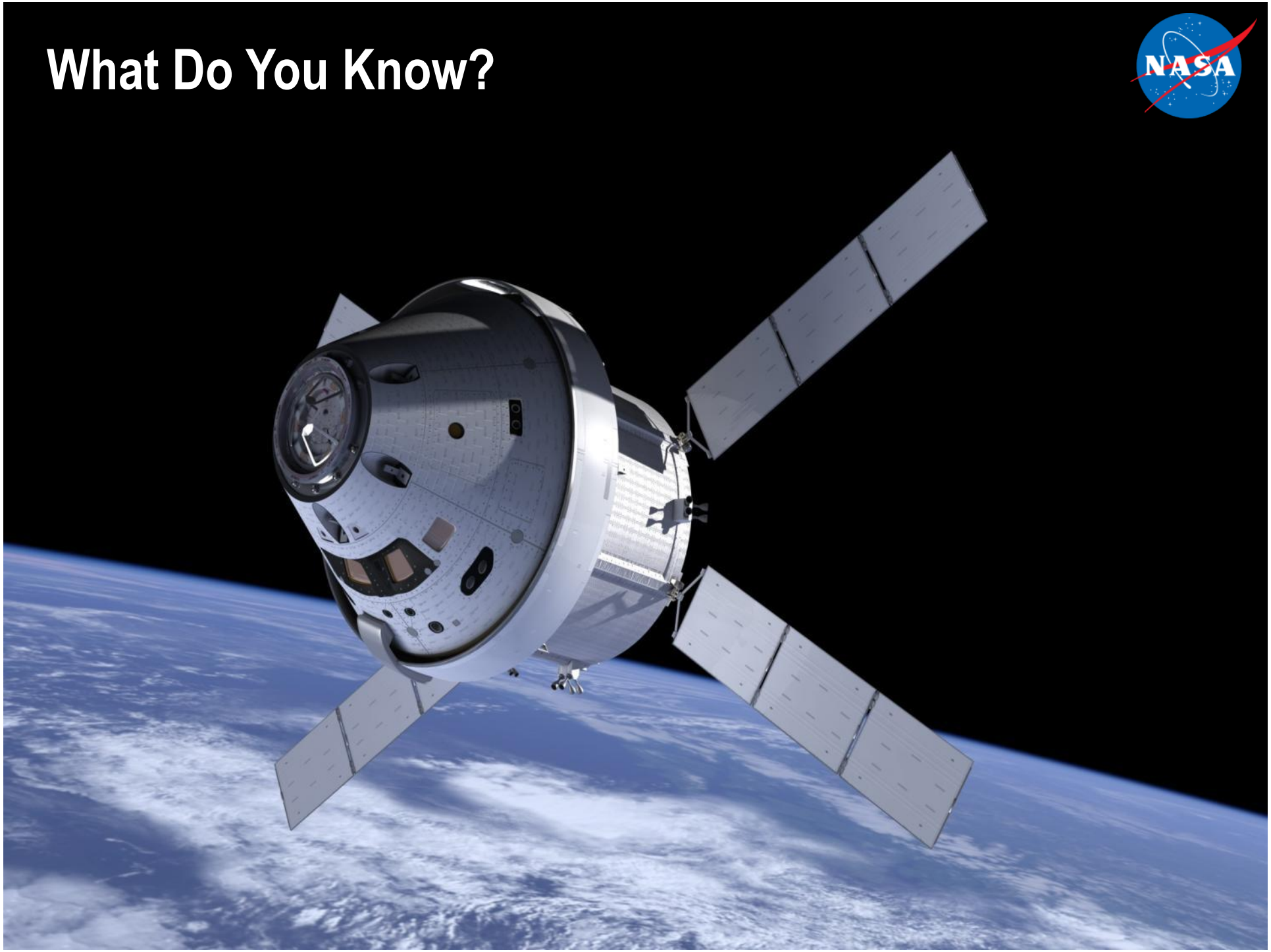


Why Do Humans Explore?

Discovery | Scientific Knowledge | Returning Benefits To Humanity
Technology & Economic Growth | Expansion of Human Civilization | International Cooperation | Public Engagement

Last Updated: 05/03/2013

What Do You Know?

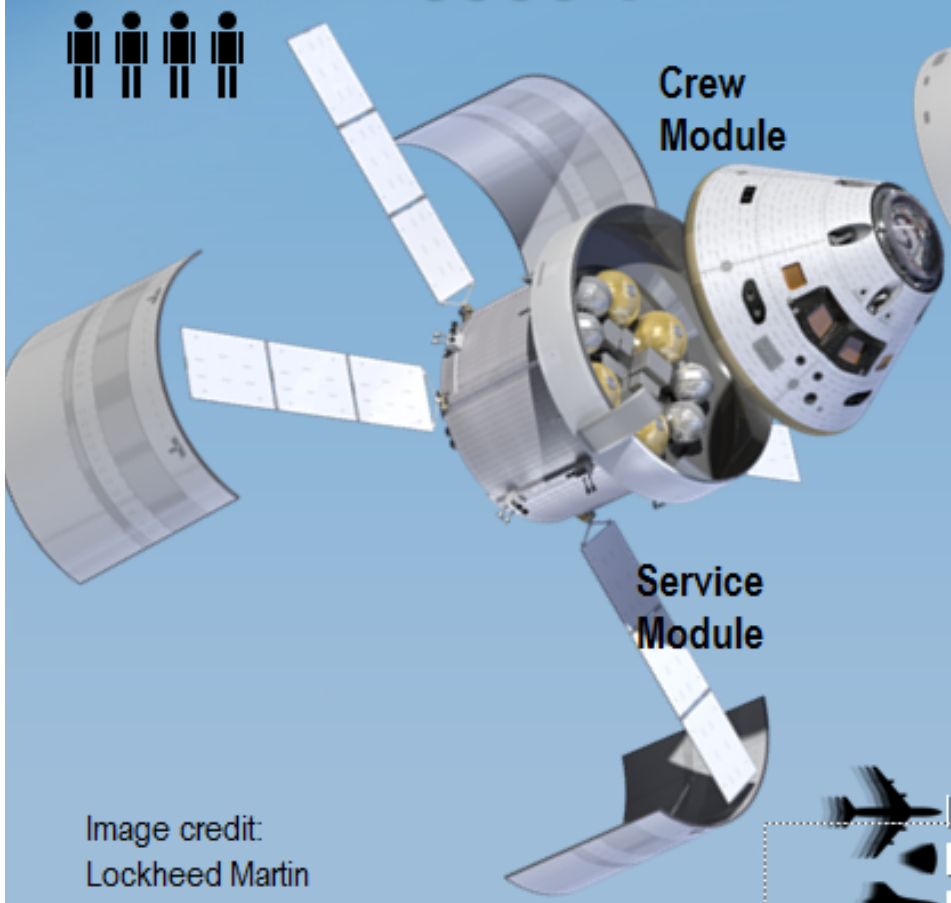


Orion Spacecraft

The Orion vehicle will carry a crew of 4 astronauts and is designed for missions up to 600 days.

The Orion heatshield can withstand temperatures up to 6000º F, nearly half the temperature on the surface of the sun.

6000ºF



13,000

The crew module returns to earth at a speed of 27,000 miles per hour, 1.5 times as fast as the space shuttle, and 45 times faster than a commercial airliner.

If the launch abort motor energy could be converted to electric power, it would be enough to power 13,000 houses for an entire day.

27,000 mph!

Image credit:
Lockheed Martin

Testing – Think Like a Scientist

Teamwork

What are benefits to working in a team?

Record Data and Observations

Predict and test to find the number of sheets required to completely block the light from your flashlight.

Record Data
PART 1:
Ray Shielding Analysis Chart

Dimension of sheets in centimeters:

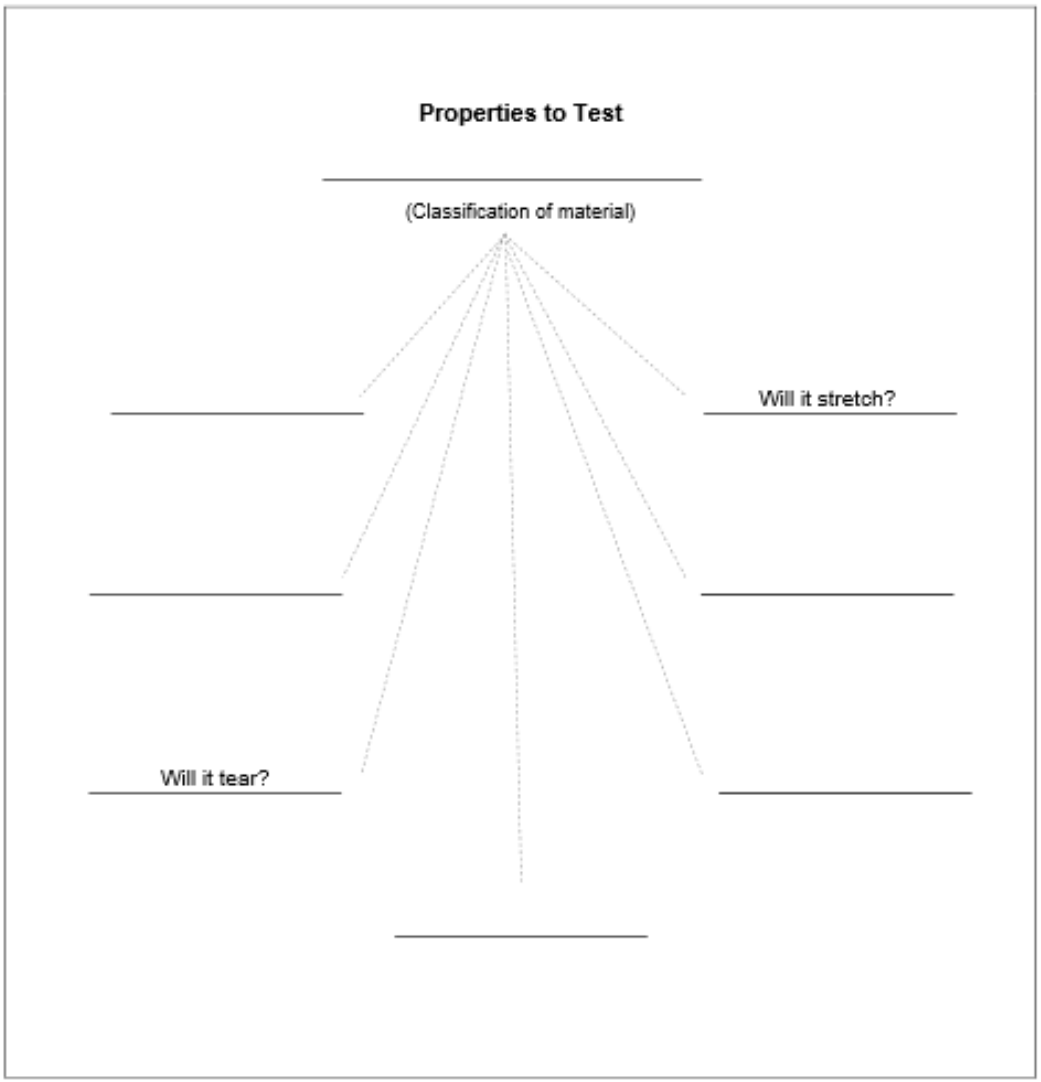
Length _____

Width _____

	Copy		Tissue		Card stock		Construction	
	Predict	Actual	Predict	Actual	Predict	Actual	Predict	Actual
Total weight of all sheets in grams								
# sheets to block the simulated space radiation								

Record Data and Observations

Record Data
PART 2:
Further Materials Analysis Web



Decide which properties you want to test.

Record Data and Observations

Record observations about each of the properties you chose to test.

Record Data
PART 2:
Further Materials Analysis Chart

Rank the materials from 0 to 5					
0	1	2	3	4	5
No sign of property		Medium sign of property			Large sign of property

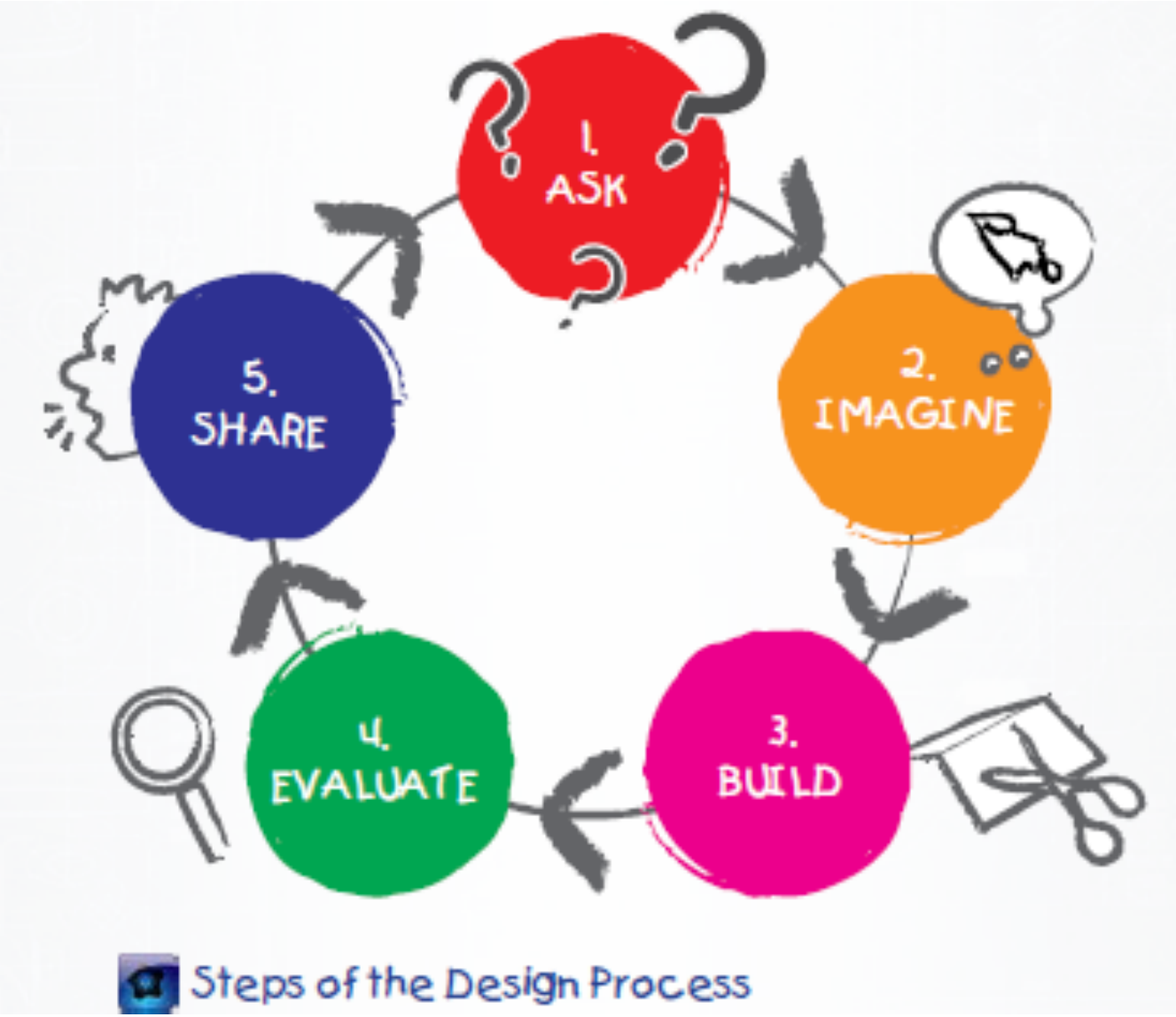
Property to test	Describe the test	Copy	Tissue	Card stock	Construction
Will it tear?	I will tear the material with my hands.				
Will it stretch?	I will pull outward on the sides of the paper.				

Build – Think Like an Engineer

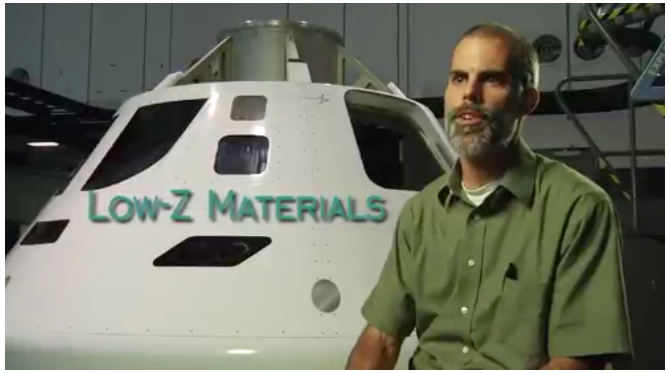
Problem Statement:

Using the materials tested, how can we design and build a radiation shield that will block visible light?

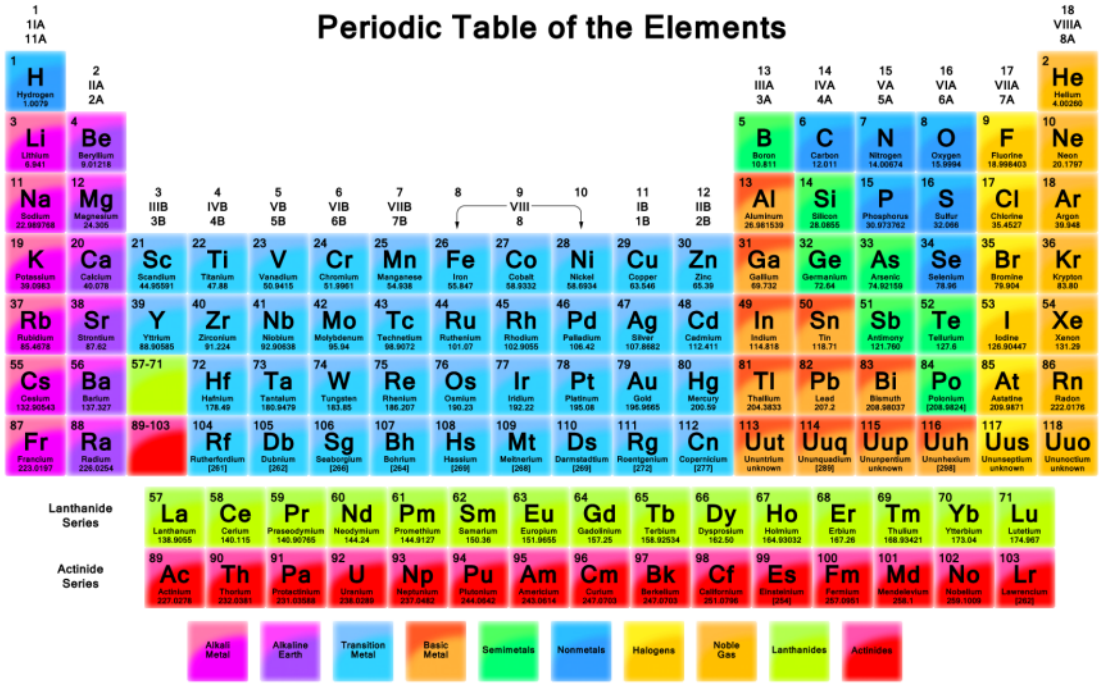
Engineering Design Process



Evaluate – Improve Your Model

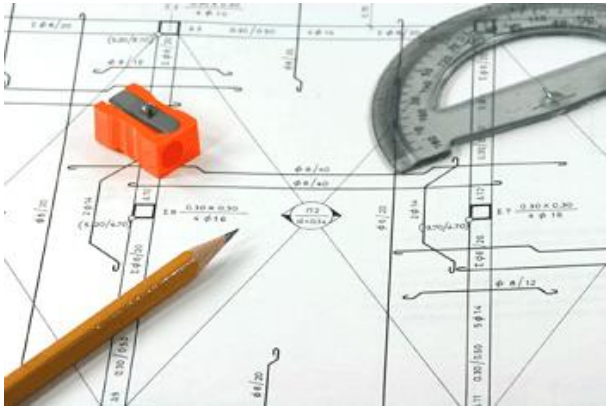


What are low-Z materials?



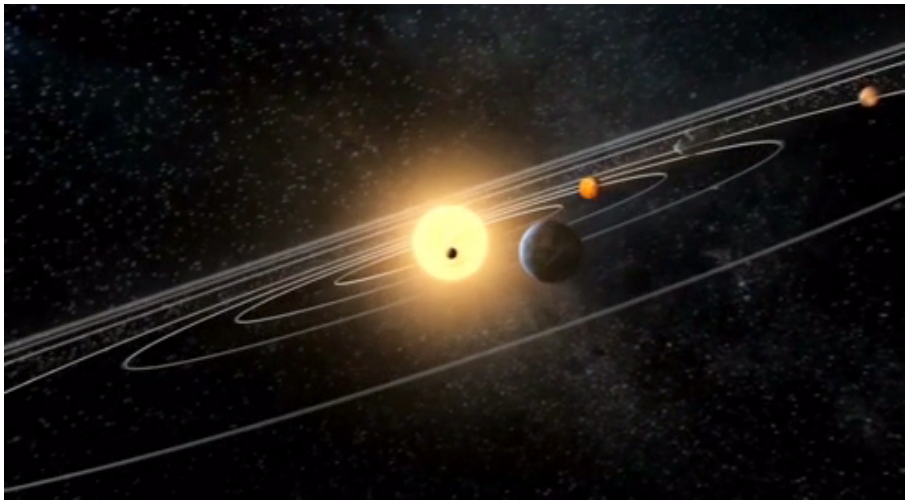
Evaluate – Improve Your Model

What are some easy-to-find low-Z materials?

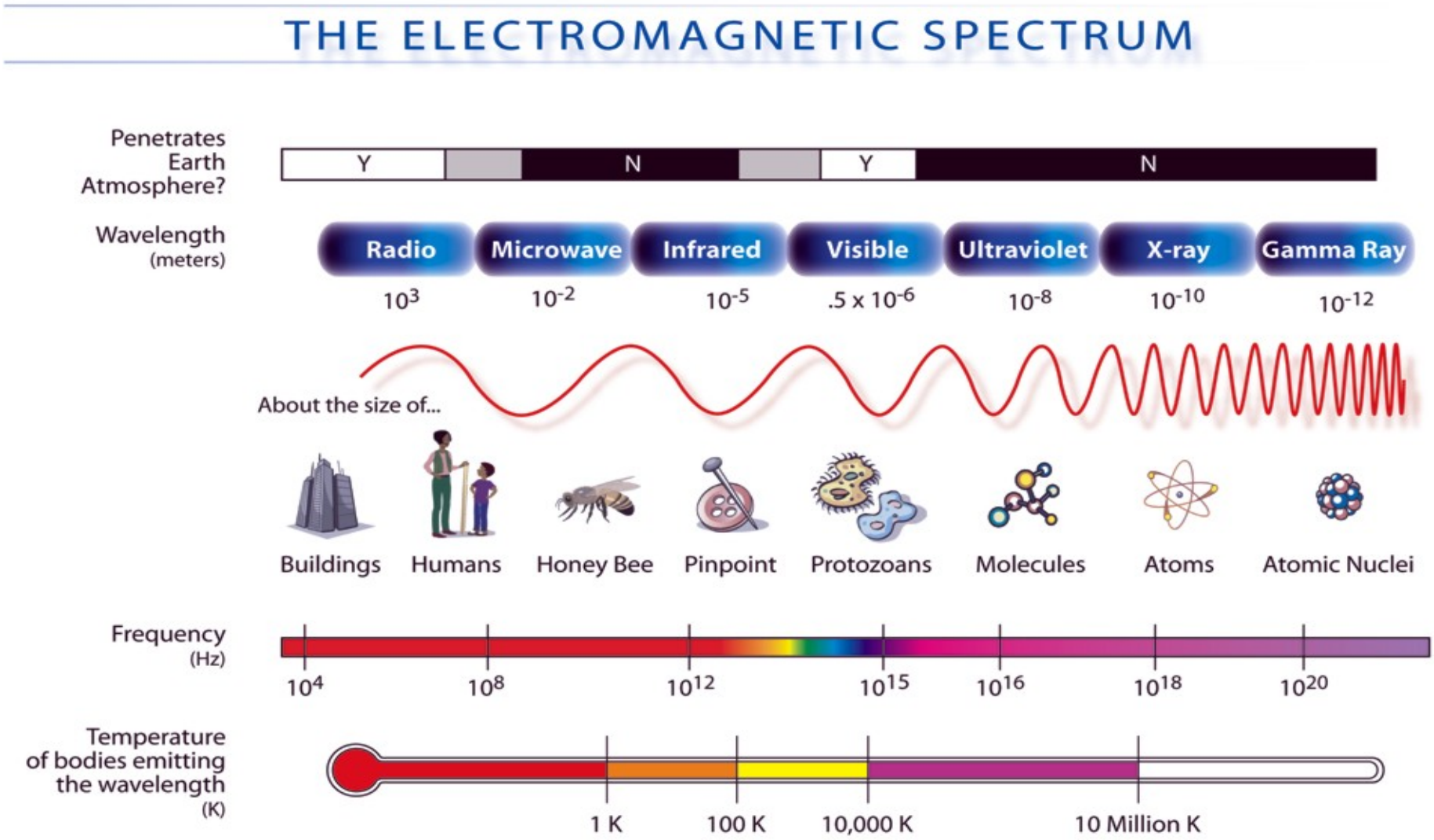


Space Radiation

How is radiation in space different from radiation on Earth?



Electromagnetic Spectrum



Science and Engineering

How do scientists and engineers work together?

How does what we know about radiation influence the design of Orion?

Re-Design – Think Like an Engineer

Re- design and build a radiation shield that will block both visible and UV light.

Congratulations!